Near Space 2015

A Conceptual Vision of Near-Space Operations

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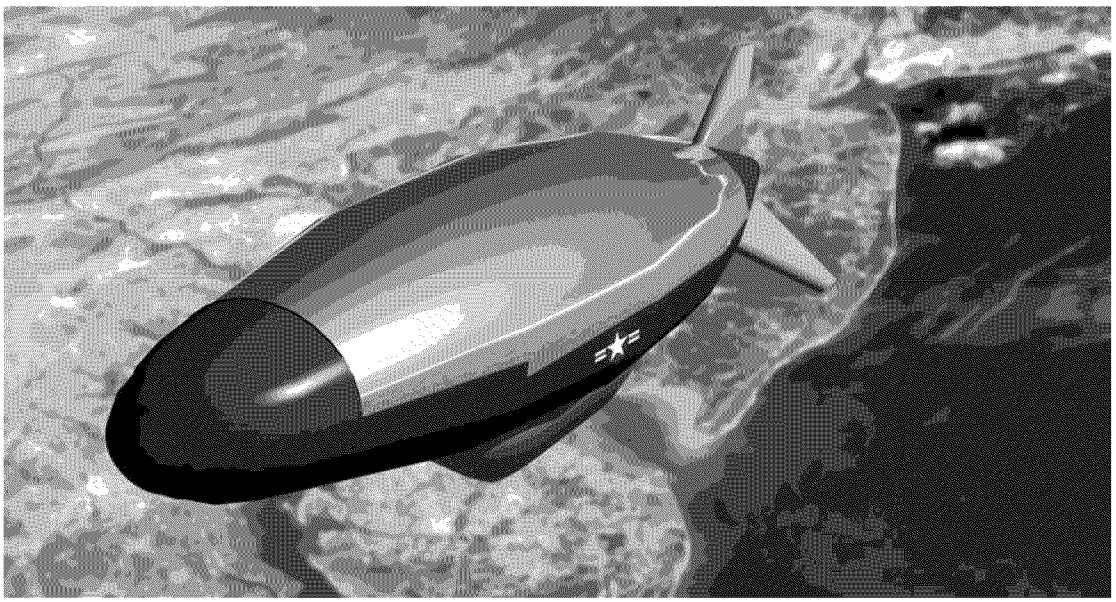
Editorial Abstract: Major Steves presents a fictional account of an Air Force unit in 2015. In this scenario, from a perch too high for most aircraft to reach but too low for most space objects to orbit, airships provide reconnaissance and communication services for military operations ranging from combat missions to humanitarian assistance.



THE FOLLOWING STORY is fiction. It depicts a "week in the life" of a hypothetical Air Force organization conducting near-space operations in the year 2015. The systems described are based on current concepts, both real and proposed. Projected timelines for developing such systems make the following scenario plausible. Although the story rests on these factors, the vehicles, payloads, organizational structure, and missions remain the fabrication of the author and have no direct relationship to any specific contractor proposals.

The near-space realm has no official or legal definition. Loosely, the concept refers to very high altitudes above which most aircraft cannot fly, but below altitudes at which satellites and other space objects reach orbit. Current proposals focus on technologies that would operate between 65,000 feet (20 kilometers) and 325,000 feet (100 kilometers). We have long known of the benefits of a platform able to function in the near-space realm. Both manned and unmanned aerial vehicles (UAV) have flown at near-space altitudes for decades, albeit for short durations. In 2006 advances in

technology allow us to envision long-duration operations in near space. The US military, other government agencies, and commercial providers have all recognized the immense potential of this realm. Aggressive programs now under way seek to create a family of near-space systems to provide true persistence to a variety of users.

Our story begins in the year 2015. Collaborative efforts of the Department of Defense (DOD) and industry have resulted in three distinct near-space systems. Small, hand-launched balloons incorporate a glider system to return payloads after transiting a region. Joining these semiexpendable systems are large, fully reusable airships and high-altitude lightweight UAVs (HALU). All of these systems are operational and controlled by Air Force Space Command's 1st Near Space Group (NSG). We begin this week on a typical Monday morning as day-shift operations begin. . . .

Monday

Maj Hilary Newman, USAF, arrives at the 1st NSG operations building early in the morning. A unique organization, the group is responsible for the near-space systems in use by the US government. Based at Edwards AFB, California, it has units based worldwide to provide near-space capabilities as needed—anyplace and anytime. Major Newman begins her week as commander of the day-shift operations crew. Manned round-the-clock, the operations center is the hub of all near-space operations for the DOD. The ops-crew commander serves as the conductor, overseeing a team of officer, enlisted, and contractor personnel who monitor and control the active near-space systems. As Major Newman receives her changeover briefing from the night-shift commander, the rest of her team members arrive and assume control over their individual stations.

Of primary concern to the ops crew this morning is the health and status of the on-station airships. Over 600 feet long, the stratospheric airships are the "Big Daddies" of the near-space fleet. Capable of lifting 2,000 pounds of payload, these remarkable craft have more

in common with the great dirigibles of the 1930s than with the smaller blimps that most people recognize from sporting events. In addition to giving the aircraft its torpedo shape and rigid structure, the combination composite-and-metal skeleton acts as a frame upon which the propulsion, power, and payload systems rest. Hydrogen gas fills internal ballonets, providing the lift necessary to keep the massive craft airborne. Propelled by four ducted fan engines, the airship can reach a top speed of 45 knots. Flying with prevailing winds allows the airship to reach almost any point in the world from its base in 10 days. Once on station, the craft drives itself to an operational altitude where it sets up a station-keeping pattern based on wind speed and direction. Remaining there for the standard six-month time frame requires a renewable power source. Thus, thousands of square feet of ultraefficient photovoltaic cells cover the top half of the airship, converting radiant sun energy into stored power. Because they fly above the clouds, the airships have uninterrupted sunlight throughout the day. At night, the batteries release their power to the airship's systems and payload. This energy-efficient system allows round-the-clock operation for a full six months.

Major Newman and her team have as their first priority checking the status of the five air-

ships currently in the air. Because the airships remain on station autonomously, no one has to "fly" them manually from the ground. After technicians enter coordinates from the global positioning system (GPS) into the redundant onboard computers, the craft will maintain itself within a predetermined footprint. Satellite-communication links to the ops center provide real-time telemetry of the airship's position and health. Any deviation of position or anomaly in the platform or payload triggers an immediate alert at the corresponding monitor station. If necessary, a trained operator can assume control of the airship, but switching to redundant components usually solves such problems. A quick check by the incoming crew confirms that all five airships are in the proper location, performing their missions.

Three airships are currently assigned to the Department of Homeland Security and the North American Aerospace Defense Command (NORAD). The new fleet of lighter-than-air craft drew their names from the first US military balloons used during the Civil War: the *Intrepid* and the *Washington* fly a slow pattern up and down the east and west coasts of the US mainland, with the *Excelsior* monitoring the southern border. As new airships come online, they will add to the coastal monitoring duty, filling in gaps that exist with only the two current assets. The data from their onboard sensor suites goes directly to NORAD, which shares it with the Office of Homeland Security. This data provides a lookout capability of hundreds of miles, monitoring the air, ground, and maritime traffic approaching our borders. Before the airships assumed this mission, border coverage was spotty. Now, however, it has increased to nearly 100 percent all the time.

The two remaining airships flying today provide support to the US military. Tensions between the allied Iraqi nation and Iran have caused concerns for our troops stationed at bases there. US Central Command requested that the *Constitution* monitor the border for any signs of hostile activity. The *Eagle* provides support to the Navy, maintaining station over a carrier battle group on maneuvers in the Pacific. Because of the situation in that area, it has become standard practice to assign an airship to the Navy to provide unparalleled over-the-horizon monitoring in all directions around the fleet. With all five airships on station and in running order, Major Newman and her team settle down to what they hope will be an uneventful day.

On the other side of the world, the unit responsible for another near-space system also hopes for a quiet week. Located at a Royal Air Force base in the United Kingdom (UK) and responsible for HALUs based in the European theater, the HALU-Europe squadron is one of two planned regional HALU units. Next year the HALU-Pacific squadron will station its fleet of aircraft at an airfield in Japan. Until then, the UK-based team bears any HALU taskers that come down. The newest arrow in the near-space quiver, the HALUs have been operational for only a year. These vehicles—evolutionary upgrades from the UAVs used for the past decade—differ from the older systems in two crucial ways: autonomy and persistence. Designed to fly without human input, they typically require manual control only during takeoff and landing, when the aircraft's 220-foot wingspan can create problems. Once at altitude, the onboard flight-control system flies the aircraft to the proper coordinates to begin its racetrack pattern. Additionally, whereas other UAVs can loiter for perhaps two days, HALUs can remain on station for up to two weeks; such persistence makes them true near-space assets.

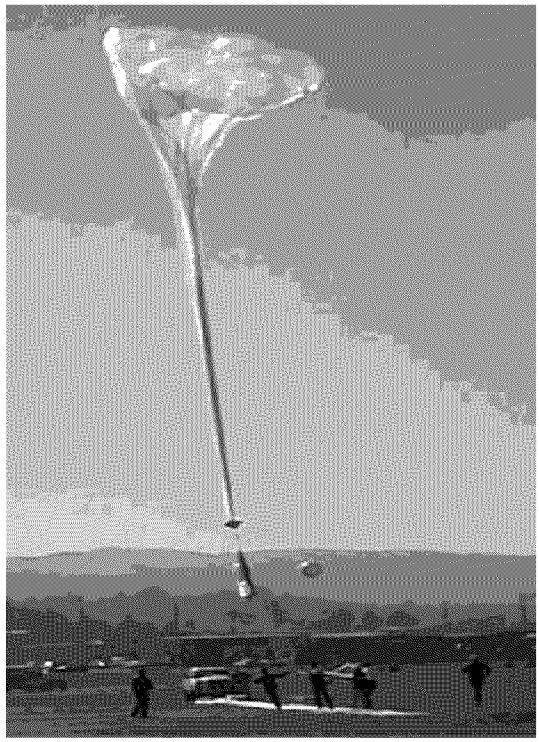
Because of the time difference, Lt Col Toby "TR" Masino, the HALU-Europe squadron commander, began his day hours before Major Newman went on duty. Colonel Masino ensures that the five HALUs in his care remain at a constant state of readiness. Although the big airships provide the most lift and endurance, they still take more than a week to arrive at their destination. But conditions in today's world sometimes demand a more rapid response. Unlike the airships, HALUs can reach nearly any location in their hemisphere in just one to two days. True, their payloads of 1,000 pounds amount to only half that of the airships, but that's still enough to meet the needs of vital communications and/or reconnaissance missions. Not powered by solar energy,

they usually stay on the ground until needed. A modular "plug-and-play" design unites the airframe and payloads, allowing the squadron to have a variety of payloads on hand for quick integration. Colonel Masino's team has just finished two weeks of exercises over Africa, so he's looking forward to a quiet week of rest and refurbishment.

Another 1st NSG team, however, is just beginning its mission. In a friendly Central American country, MSgt Ed Grant oversees the arrival of his balloon team—one of two teams in the 1st NSG responsible for deployed operations of the Tactical High Overhead Resource (THOR) balloon system. One of the first near-space systems to become operational back in 2006, THOR began as a demonstration program but exceeded everyone's expectations and quickly entered into service. After proving its worth in combat operations, it became a standard feature for US military operations worldwide. Today, the team is deploying to support a special operations mission to extract American hostages held by narco-terrorists.

The THOR system employs a rather simple concept: suspending a glider with an internal payload from a balloon. After reaching a preset altitude, the balloon drifts with the wind over a region of interest. At the conclusion of the mission or before the balloon drifts into unfriendly territory, the glider detaches from the balloon. Using onboard GPS, it autonomously flies back to a secure landing zone, where crews can hook up the glider and payload to another balloon and relaunch them. Using multiple launches from an upwind location, the team can provide continuous coverage over a region indefinitely. For the upcoming extraction, enough balloons and gliders have shipped with Sergeant Grant's team for five days of continuous coverage—although everyone hopes that only one day will suffice.

As Monday draws to a close, Major Newman and Colonel Masino have caught up on some paperwork. Sergeant Grant gets his team into quarters and then works on the ops plan for the upcoming mission. As the midshift begins its duty on the ops floor, the near-space airships keep watch high above their assigned areas.



THOR balloon system

Tuesday

Tuesday morning dawns bright and clear over the California desert. Major Newman performs her shift-changeover duties and attends to her checklist items. After establishing the state of the on-station airships, she contacts the various parts of the 1st NSG that are conducting their own operations.

First she calls Colonel Masino, who reports a ready status for his HALUs. The second call goes out to Sergeant Grant and his deployed THOR team, who have arrived at their operating base along the Central American coast. Veterans at this sort of task, the teams deploy about eight to 10 times per year to provide short-duration near-space support. Regular Army, Navy, and Marine Corps units have integrated balloon operations into their own forces. Each month the 1st NSG training squadron runs sessions for selected troops to learn the ins and outs of balloon operations. This training gives ground-force commanders

an internal near-space balloon capability without having to call on the 1st NSG to deploy to every theater, leaving the THOR-deployable teams free to support smaller units such as the special ops on today's hostage-rescue mission.

Equipment checkout for the team includes assembling the gliders, integrating the payloads (in this case, communication-relay repeaters), and inspecting the balloons. As with every deployment, the team has brought more supplies than it should need. Because of the critical, time-sensitive nature of the operations, the team can't wait for replacements or additional equipment to arrive. Besides, even with advances in weather-prediction tools, forecast accuracy remains limited. Strong winds can push a balloon across the designated area in a matter of hours, requiring the launching of more balloons. Or a single balloon can effectively hover over the area for a day or more, with the mission ending only when the onboard batteries are depleted.

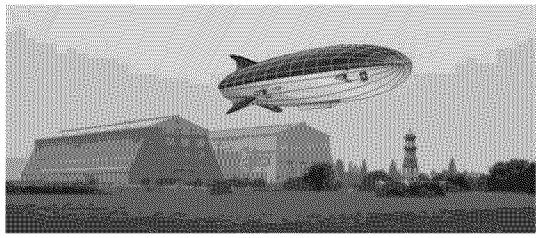
Sergeant Grant checks with his weather expert for the optimum launch location. Accurate weather forecasts are vital to the success of the mission since the team needs to know where and when to release, based upon wind speed and direction at altitude. Because the extraction operation has a small window, they will launch multiple balloons to provide redundancy in case equipment malfunctions or the operation runs longer than planned. All seems set for balloon releases at 0130 local time. Sergeant Grant informs Major Newman of his team's status and schedule; he then signs off to give his troops some rest before they commence operations.

For her last call of the morning, Major Newman checks with the maintenance squadron, whose job this week entails final preparations for launching the airship *Union*—the oldest in the fleet—named after the first US military balloon. Since returning to base three weeks ago, the *Union* has undergone routine refurbishment, which includes inspection of the 50,000 square feet of solar arrays for damage and replacement as necessary. The fabric skin and internal structure of the airship undergo inspection as well. Previously deployed for border-monitoring duty over the United States, the airship received a new payload last week for its upcoming mission. All the airships have proven themselves tough, requiring little maintenance after a routine deployment, so the *Union* will launch tomorrow and begin its transit to replace the *Constitution* over Iraq—weather permitting, of course. The airships can remain at altitude for months, but they are difficult to maneuver close to the ground. Because of the wind limit of 15 knots for launch, the craft typically depart in the calm desert air of early morning. For the rest of this day, Major Newman will prepare her team for tomorrow's launch.

Tuesday draws to a close just as it began—quietly. But tomorrow will be an entirely different story.

Wednesday

The *Union* rolls out of its immense hangar in the predawn hours. The crew encounters no problems during rollout, and the weather is picture perfect for launch. Major Newman's team at the ops center performs its prelaunch checkout and ensures that the airspace has been cleared. At the hangar, the visitors assemble. Even today, an airship launch draws a crowd. The 600-foot-long craft dwarfs everything except its hangar. It doesn't linger on the ground very long. Any wind gusts could make the airship hard to handle and dangerous to the ground crew, who checks the *Union*'s systems—especially the command and control system, which will guide this giant on its journey. Back in the ops center, Major Newman watches her team closely, and all systems check out green. With a final go/no-go check, the order comes down to release the airship from its mooring mast, and the vehicle takes to the misting morning sky. Slowly at first, the airship begins to rise. The large, ducted engines point the vessel into a nose-up attitude. The airship doesn't need the engines to reach altitude; they provide direction to make the ascent as efficient as possible. Weather-squadron personnel, who have already mapped out the upper-air wind speeds and directions, are in contact with other weather forecasters around the world. Thirty minutes later, the airship has be-



Union *airship*

come a mere dot in the sky. After just over an hour, it has reached cruising altitude.

Utilizing jet-stream winds, the *Union* rides the currents in a west-to-east pattern on a preprogrammed flight route. Avoiding any country's overflight restrictions, the airship follows a path to the Mideast that should have it arriving in eight days. Once in motion, the airship assumes control of its flight. The autonomous guidance system constantly updates its position via GPS satellites and monitors speed and direction. The ops-control team can manually input commands but only rarely needs to. For the next week, the team will monitor the airship's progress as it makes its way across the world. Once it arrives over Iraq, control authority for both platform and payload will transfer to the local commander.

The relative quiet that Major Newman and her team have enjoyed this past week comes to an end early in the afternoon. They hear reports of a major earthquake on the Indian coast, first on the news and then through the 1st NSG's Tasking Office—the conduit for any potential users of the group's near-space assets. Normally they support DOD users but sometimes receive requests from other government agencies, allies, and even foreign countries. Today, as the scope of the earthquake becomes clearer, Major Newman and the team realize that a major humanitarian crisis may soon unfold. The Indian government quickly calls for assistance from any nation, and the United States responds. In addition to the typical disaster relief that our country always rapidly provides, these days the world looks to US near-space assets for critical help. Although the 1st NSG can't deliver blankets or food, a single near-space asset over a disaster zone can establish communications to the entire region. The first use of these craft over the mud-slide disasters in Panama three years earlier clearly demonstrated this fact, and the Tasking Office knows that the Indian earthquake may lead to a formal tasking from the Department of State.

On the ops floor, Major Newman—expecting a call-up—begins to examine her options. There are two airships on station in that part of the world, but the Navy craft isn't carrying the correct type of payload. The *Constitution*, on the Iraqi border, could carry out the task, but it's unlikely to receive an order to abandon its current mission. The *Union*, launched this morning, could revector to assist in the short term, provided the *Constitution* can remain on station a little longer. But it will take the *Union* a week to arrive at the disaster site. Since she needs something more immediate, Major Newman decides to give the HALU-Europe squadron a heads-up.

In the United Kingdom, Colonel Masino isn't surprised by Major Newman's call since he's been watching the news as well. After receiving an update from her, he decides to start recalling his team. Confident of an imminent tasking order to use his HALUs in the relief effort, Colonel Masino wants to be ready to roll when he gets the word. The five aircraft stay in a normal state of readiness, but he raises them to an even higher level of alert and has his team start prepping one of the aircraft with a standard communications payload. In addition to providing relay for ground-to-ground radios, the payload also serves as a satellite-communications booster, allowing ground personnel to use low-power radios to talk through satellites to any location in the world. In only three hours, a HALU stands loaded with the payload and positioned for fueling. Because of the hazards associated with fueling, Colonel Masino holds off on that last act until formal notification arrives. In the meantime, his controllers have already plotted the best possible route from the UK base to the disaster zone. The HALU can arrive within 24 hours after launch and should be able to loiter for 10–12 days. If necessary, his people can launch a second HALU or perhaps redirect an airship. During the process of ex-

amining all these possibilities, Colonel Masino gets the tasking order: launch the HALU!

Members of the fueling crew move around the aircraft in their protective clothing, loading the liquid hydrogen. The specialized hangars at the base allow inside fueling, out of the weather. In the event of strong winds or winds blowing from the wrong direction, the HALUs stay grounded. Luckily, today's conditions are favorable, so the HALU shortly begins its taxi to the end of the runway. At this stage, a certified pilot from the squadron's ops center manually controls the vehicle. A similar setup back at the 1st NSG at Edwards AFB could control the HALU as well, but today those personnel only shadow the takeoff. After final checks of the craft's systems and an all-clear from the tower, the aircraft begins to roll slowly down the runway, and after using a good two-thirds of it, the HALU begins to rise. The great wings, drooped while the vehicle rested on the ground, now rise up, lifting it into the sky. The HALU performs no radical maneuvers or barrel rolls upon takeoff—just a gentle turn to line up on the predetermined heading. Like an airship, the HALU takes advantage of prevailing winds at lower altitudes to reach its destination as quickly as possible. As it approaches India, it will climb to 65,000 feet and begin to orbit the disaster area. But that won't occur until tomorrow. For now, Colonel Masino turns over control of his HALU to the team back at Edwards and starts prepping another vehicle in case it is needed.

Thursday

By 0130 local time on the Central American coast, Sergeant Grant's THOR team members stand ready for their first balloon release. They use hydrogen bottles, filled the day before, to release three balloons tonight. Based on the wind speed and direction, they can launch inside their deployed base. At the proper time, the inflated balloon attaches to the small, lightweight glider, which contains the relay payload that will provide communications connectivity to ground and airborne forces conducting today's operation. An hour after release, the balloon reaches an optimum altitude of 70,000 feet. The THOR's command and control system, operated via laptop by the launch team, monitors the ascent and commands venting and ballasting to hit the target altitude. Because of the good weather and relatively short distances involved, the gliders for tonight's operations will fly back to their launch location after separation from the balloons. The THOR teams can deploy a separate recovery crew if necessary, but Sergeant Grant is glad that he doesn't have to split his team today.

Three hours later, the team releases the second balloon, and the extraction mission is a go. As this balloon drifts over the target area, controllers switch on its payload systems and switch off the first balloon's payload. At this point, they command the first glider to release from the balloon. After plummeting for several thousand feet, the glider begins an automatic pullout and orients itself back to the launch location, over 200 miles away. Forty-five minutes after release, the glider performs a soft landing in the predesignated clearing. Sergeant Grant remains unaware of the operation's progress, but deep in the jungle the special forces troops consider his balloon a lifeline. As they strike out to the terrorist camp, their small tactical radios maintain contact with the recon unit monitoring the site and with the air-support helicopters in a holding pattern several miles away. Before the use of near space, such communication was impossible because terrain reduced a radio's effective range to about five miles. Now troops can talk to forces over 350 miles away. After rendezvousing with the recon team, they call in air support and begin their attack. Catching the terrorists completely off guard, the special forces quickly infiltrate the compound and rescue the American hostages. Within 10 minutes, all of them exit the camp, and helicopters come blazing in to pick them up.

Back at the launch location, recovery-team members retrieve the first glider and load it into their vehicles after notification of mission success. They then command the second glider to release and return to base. Knowing that their systems saved lives today, they are justifiably proud.

By the time Major Newman arrives for the start of her day, the THOR team has recovered all its equipment and has packed up. She finds it pleasing to report up the chain not only the team's success, but also the HALU's good progress and likelihood of arriving over the disaster area later today. Having coordinated with the various military and civilian relief agencies descending on the area, the 1st NSG's Integration Office needs to ensure the most effective use of the communications services provided by the HALU.

Like the day before, Thursday holds some surprises. On the ops floor, Major Newman notices an alarm at the station monitoring the airship *Eagle*, which supports the Navy carrier fleet. Apparently, the craft has blown off station. The upper-level winds have started gusting, blowing too hard for the airship's engines to fight. The ops floor swings into action, first gathering accurate weather data for all altitudes around the airship's position. Perhaps it's possible to rise above or go below the gusting winds to regain station. The weather-squadron personnel on shift discover a layer 5,000 feet lower than the current cruising altitude that would allow the airship to recover over the fleet. Even better, they do not foresee the higher winds at operating altitude lasting very long—good news because operating at lower altitudes requires more engine performance (therefore more power). Although they have not yet reached a critical threshold, if the engines cannot handle the power requirements, the payload might need to shut down. In the worst case, the airship would have to drift, sometimes hundreds of miles, until the batteries recharge sufficiently to allow the airship to fly back to its station—something that happens periodically to almost all of the airships.

Fortunately, the gigantic footprint from near-space altitude often means that the data flow remains uninterrupted, and users on the ground have no idea that their airship is no longer directly overhead. In only rare circumstances are the airships unable to recover within a day or two. The loss of a near-space asset, even for a day, sounds the alarm bells. Already informed of the temporary loss of his big eye-in-the-sky, the fleet commander on the Navy ship launches conventional aircraft to take up the slack. Formerly the norm for providing fleet defense, these aircraft now launch only rarely. Major Newman considers this scenario a prime example of the vital importance of near-space assets in today's world. It seems hard to believe how we conducted operations without them.

For the *Eagle*, a new flight plan will take it to a lower altitude. By the time the day shift ends, the airship is heading back to the fleet. The midshift team will take it the rest of the way.

Friday

Friday typically signals the end of a work week. But for the men and women of the 1st NSG, the work week never ends. The HALU begins to circle over the Indian disaster area, its payload providing communications coverage to a devastated region. Relief forces in the most remote and hardest-hit areas can now communicate with the aid center, arranging for medical airlift and supply delivery. Six airships are in the air; the *Eagle* has come back on station, shadowing its Navy user; the *Union* rides the jet stream east to Iraq; and the THOR team prepares to head home.

Back on base, Major Newman takes her lunch break to watch the dedication of their newest airship hangar. Although it contains upgrades such as a new fueling system and mobile scaffolding, this structure's retractable roof sets it apart. Operating much like a sports stadium, the roof will allow airship launches in all but the most severe weather, thus improving the team's ability to meet users' needs for near-space platforms.

Major Newman is proud to be a member of an organization that has become so significant to military operations in such a short time. The vision of Air Force leadership in the past several years—aggressively pursuing near-space systems to operational status—has paid off. Near-space assets fly every day in all corners of the world, providing support to military, diplomatic, security, and humanitarian causes. People now take their presence for granted, and Major Newman can only imagine what future fleets will ply the near-space realm. ❑